ECL 113

THE GO-MATIC ACCESSORY FOR MOTORCYCLES

Go-Power Corporation, a small Palo Alto, California concern, started as a tiny basement workshop in 1959. Mr. Neal Williams, now its President, was a sophomore at Stanford when he started Go-Power with an investment of 180 dollars. Over the years the company has successfully marketed a number of products on the periphery of the automobile industry. So successful have been some of these items that Go-Power's gross annual sales exceeded three quarters of a million dollars during 1968. However, among the company's products there was one called Go-Matic which failed to keep up to its early promise.

 This case was suggested by Professor P. Z. Bulkeley and written by Mr. Prem C. Garg. The cooperation of Mr. Neal Williams is gratefully acknowledged.

Go-Matic (Exhibit 1) was marketed as an accessory for light-weight motorcycles*; it enabled the user to change the motorcycle instantly from trail to street version**. In principle Go-Matic was a fairly simple piece of equipment, basically a gear shift mechanism. Exhibit 2a shows an exploded view of the Go-Matic assembly. The main housing (no. 522) was mounted on the rear swinging arm of the motorcycle (Exhibit 2b) and it in turn supported the main shaft (no. 515). Three sprockets were mounted on the main shaft. The center drive sprocket, connected to the engine output shaft, was flanked on either side by a driven sprocket. The driven sprockets were connected to the two rear wheel sprockets (Exhibit 2b). The drive sprocket could be meshed with either of the two driven sprockets with the help of a drive key (no. 519). An actuator lever (no. 521) shifted the drive key through the actuator shaft (no. 516). By moving the drive key one way or the other, the motorcycle could be run in either of the two speed ranges.

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* Specifically for the following models: Honda 100, 101, 102, 105, 110, CT200 (Trail 90) and CA 100 (Street 90); Yamaha MG-1T, YG-1T, MJ-2, MJ-2T, and YJ-1; Suzuki M-15, M-30, K-10, K-11, and K-15.

** Trail versions, having a speed range of approximately 5 to 20 mph, are mainly used in hilly terrain or in forests, etc. Street versions, having a speed range of approximately 20 to 50 mph, are generally used on the highways.

The idea of Go-Matic as a commercial product was suggested to Mr. Williams by Mr. Reynolds*, an inventor who had helped Go-Power with some of its earlier products. Mr. Reynolds had built up a prototype model, fabricated from angle sections, etc., and had been using it on his motorcycle for some time when he suggested it to Mr. Williams in early 1964. The idea seemed promising to Mr. Williams insofar as its instant action seemed to give it an overwhelming superiority over the existing 'Quick Change' devices which involved nothing short of major surgery for every change from one gear to the other. It appeared to Mr. Williams that even though Go-Matics would be somewhat more expensive, they should be able to attract a reasonably large portion of the vast potential market**. Mr. Williams also saw the possibility that motorcycle manufacturers would themselves incorporate something similiar in their models, once the idea caught on. "However", he said, "I envisioned a time lag of some five years before they could do it, and that seemed plenty of time, considering the fact that products of this type are not very long-lived anyway.*** Moreover, you know, in a small concern like ours one can't afford to put large sums of money into market research; one has got to take some risk."

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*Fictitious name.

**In the United States at that time there were some 1,000,000 motorcycle owners. The annual sale of new motorcycles was arond 150,000.

***Since then, Honda and Suzuki have incorporated this accessory.

When Mr. Reynolds promised to get an order for 500 units right away, Mr. Williams thought the risk well worth taking and he entered into a contract with Mr. Reynolds to use his design under an agreement that Mr. Reynolds would be paid a royalty of two dollars for every piece sold. This was to be halved after the first four years and reduced to one quarter after eight years. After ten years no royalty was to be given.

Although Mr. Williams did not have to do any extensive modification with Mr. Reynolds' functional design, it needed quite a lot of work before it could be transformed into a "salable product". Mr. Williams did a loading analysis of the whole system and found that it was under rather light loading; hence he designed most of the parts more on the basis of proportion and manufacturing ease than on the basis of strength considerations. He prepared detailed drawings for the different components specifying tolerances and materials along with a brief description of the possible manufacturing process.

Go-Power does not have any major fabricating facilities of its own. Instead it subcontracts most of its products to suppliers who specialize in different aspects of manufacturing. "This", says Mr. Williams, "is cheaper and safer for a small and growing concern like ours." Once Mr. Williams had completed the detailed design of the Go-Matic, he contacted different sources who could either supply the desired components from their inventories or could fabricate them for Go-Power.

As Mr. Williams wanted to be sure of the performance of the device before he invested in the tooling for actual production, he decided to get ten prototypes made for the purpose of testing. In this prototype batch, he changed some of the manufacturing processes so that expensive tooling would not be required (e.g. sand castings were used instead of die castings). As a result he was able to get these ten prototypes made for a total of about 500 dollars. (See Exhibit 3 for one of these prototypes).

These prototypes were mounted on different motorcycle models and subjected to a live test. When none of these specimens gave any trouble during 200 to 1000 miles of running, Mr. Williams felt confident about the performance of the product and decided to go ahead with production. He went through various quotations and, on the basis of information which he had obtained from the various contractors, sketched out a schedule for the production of a first batch of Go-Matics (Exhibit 4).

To decide about the market price of the Go-Matic, Mr. Williams did a cost analysis of the complete Go-Matic kits for the different models and found that he could sell them at prices varying from 43 to 62 dollars. This placed their prices at 10 to 15% of the prices of the new motor cycles. Also these prices left a gross margin of 45 to 60% for Go-Power after allowing for dealer discounts which varied from 33 to 40% (Exhibit 5, 6). In Mr. Williams' opinion that was a rather good margin.

Go-Matics had been on the market for barely two months when complaints about them started pouring in. The most frequent complaint was failure of the main shaft at the transistion from the smaller diameter to the larger diameter. (See Exhibit 7). There were also some breakdowns of the mainshaft bearings. Within the next 12 months, from a total of 1000 first batch Go-Matics, 40% were returned for replacement. "There may have been others who did not bother to send them back," admits Mr. Williams.

The failure of such a large proportion of Go-Matics made it imperative for Mr. Williams to have a new look at the loading situation. "My analysis again showed the loading to be very light but those broken shafts told just the opposite story. It was a sort of puzzling situation until I realized that the mounting of the Go-Matics might be of critical importance. My fear was justified when further calculations showed that even slight variations in the chain lengths or small eccentricities in the mounting of the rear wheel sprockets could raise the stress level in the shaft to many times the apparent stress. Since most of our Go-Matics were sold directly to users who mounted them without taking any particular precaution against such a possiblity, we had a great many failures.

"Once the trouble had been located, as an emergency step to guard against any large scale stress magnification due to faulty mounting, we prepared a detailed instruction

sheet for the use of persons mounting Go-Matic kits. It took about an hour to install the kit following this instruction sheet (Exhibit 8). At the same time we started working on redesigning the shaft."

"In the prototype we had made the main shaft from 1020 steel and it had worked without any trouble during the testing. To make it still better, we had made it from 1440 steel hardened to 55 Rockwell C so that it would have increased strength as well as increased wearability at the bearing sites. As it turned out even this was not sufficient to save the main shaft from suffering a fatigue failure at the transistion. In addition to the extra loading resulting from faulty mounting, the impact loading during acceleration or sudden retardation may have been another factor contributing to the failure of the shaft.

"We decided to make the new shaft from 8620 steel, hardened to Rockwell 40C. To increase wear resistance at the bearing site, part of it was surface-hardened to 55 Rockwell C by carbo-nitriding. (See Exhibit 9). Also some modifications were made in the design to reduce the stress concentration effects. (See Exhibits 7 and 9). Once we had redesigned the shaft we decided to test its performance ourselves. We made a fatigue testing rig at our shop (Exhibit 10). Neither of the samples of new shafts we tested failed under a loading of 450 lbs. after running for 450,000 revolutions. On the other hand, the

old shafts broke down under a load of 200 lbs. after runing between 20,000 to 70,000 revolutions. We were quite satisfied with this improvement so we decided to use the new shaft in the production model Go-Matic."

Though Go-Power had to replace some 10% of these shafts over a period of about one year, they performed much better than the old ones.

Most of the Go-Matics were sold directly to the users by mail. While the customers were always enthusiastic about it, the dealers showed very little interest in promoting Go-Matic despite the fact that they had been offered a handsome discount. "Possibly this was due to the fact that the mechanics employed by the motorcycle dealers usually get more work than they can handle and consequently are very choosy about the type of things they like to do. A job such as mounting a non-standard accessory like Go-Matic is generally not very popular with them."

"Mounting remained somewhat of a problem for the individual customer, even with the instruction sheet. We were loosing interest in this product ourselves as well, as we had quite a few other successful items at hand. Our sales started declining, gradually, until it became uneconomical for us to continue the advertising, etc., for the Go-Matic. We sold in total some 2700 units and we still have 300 in stock. Possibly some of the standard components in the Go-Matic, such as bearings, could be used in some of our other products.

"Mr. Reynolds got some 5,000 dollars as royalty and to my knowledge he spent practically all of it getting patents for the Go-Matic in twenty-two countries.

"We did make some 30,000 dollars out of the whole deal but the profit was grossly out of proportion to the time and effort we put into this project. We have made much bigger sums with a lot less effort. The importance of dealer cooperation in promoting a product such as this, where price of the product makes it uneconomical for a small concern like ours to pay individual attention to all the customers, was one lesson we learned from this whole affair. We also learned about the inadequacy of testing procedures to simulate actual field conditions."

Exhibits, ECL 113

Exhibit 1 Photograph, Cutaway View of Go-Matic

Exhibit 2a Go-Matic Parts List

Exhibit 2b Photograph, View of Go-Matic Installed on a Yamaha

Exhibit 3 Photograph, View of Prototype Go-Matic Gearbox and Hub

Exhibit 4 Scheduling Notes

Exhibit 5 Costing Notes

Exhibit 6 Pricing Notes

Exhibit 7 Drawing, Transmission Mainshaft (This drawing shows a 7/8 in. diameter shaft. The actual shaft was 3/4 in. diameter, as shown in Exhibit 9, but with details as shown on this exhibit.)

Exhibit 8 Instruction Sheet for Go-Matic Installation

Exhibit 9 Revised Drawing, Transmission Mainshaft

Exhibit 10 Sketch of Fatigue Testing Rig

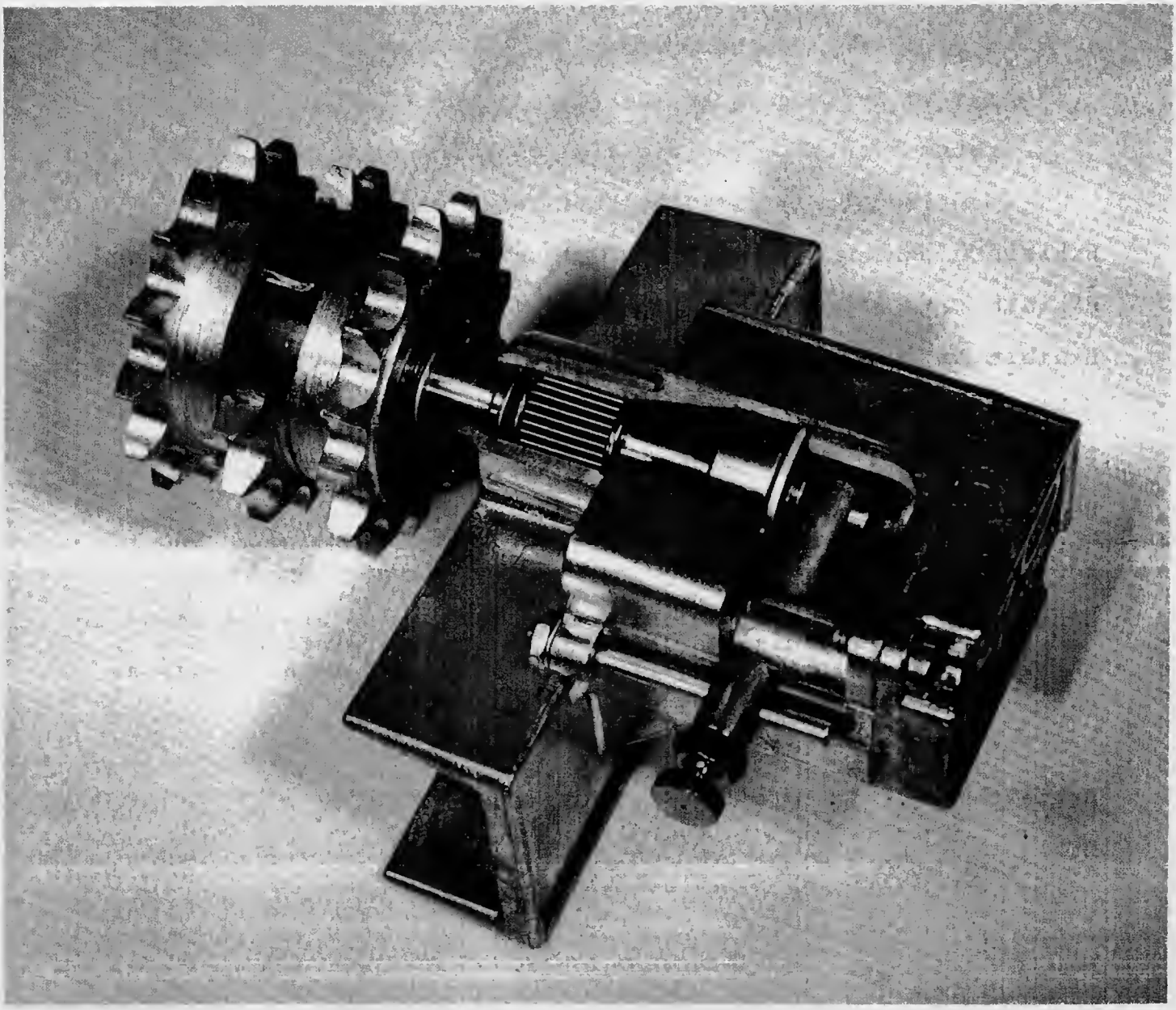
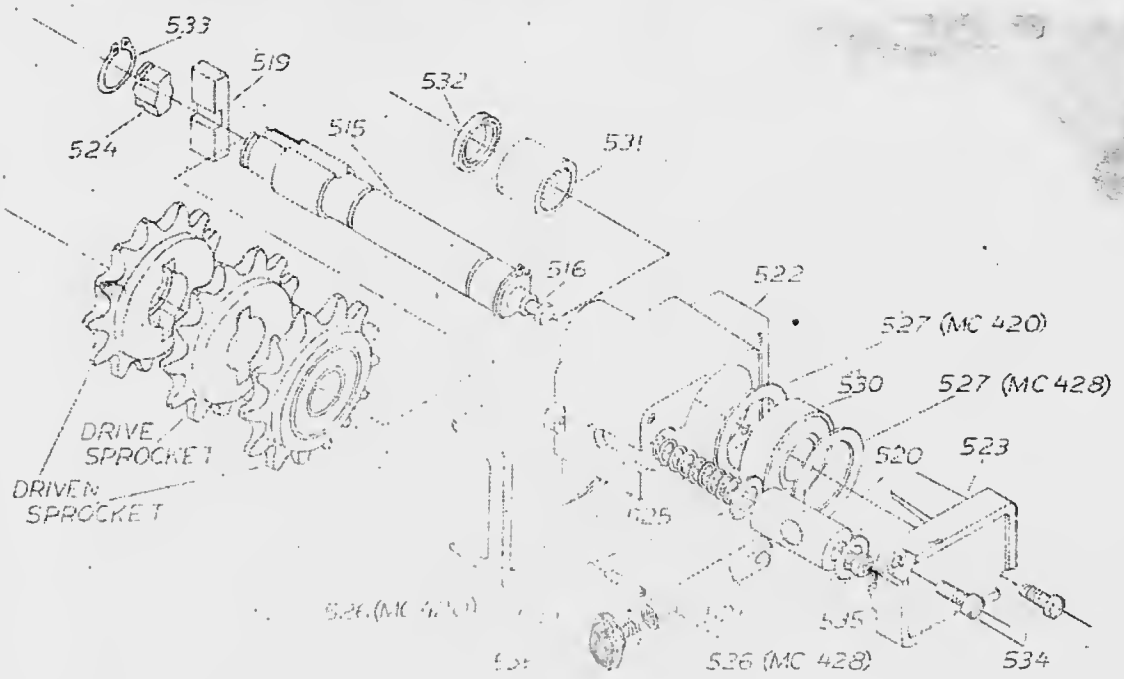


Exhibit 1 Cutaway View of Go-Matic

GO-MATIC PARTS LIST

ECL 113



Part No.	Qty.	Item	List Price
MC 515	1	Main Shaft	$ 2.90
MC 516	1	Actuator Shaft	.42
MC 517	2	Driven Sprocket (MC 420)	5.30
MC 518	1	Drive Sprocket (MC 420)	4.35
MC 513	2	Driven Sprocket (MC 428)	5.30
MC 514	1	Drive Sprocket (MC 428)	4.35
MC 519	1	Drive Key	1.50
MC 520	1	Actuator Guide Shaft	1.20
MC 521	1	Actuator Lever	.75
MC 522	1	Main Housing	2.90
MC 523	1	Housing Cap	.40
MC 524	1	Main Shaft Filler Plug	.25
MC 525	1	Spring	.20
MC 526	1	5/8" d. Spacer	.10
MC 527	1	1 3/8" d. Spacer	.10
MC 525	1	Go-Matic Label	.20
MC 529	1	Remote Shift Handle	5.10
MC 530	1	5/8" ID x 1 3/8 OD Ball Bearing	1.25
MC 531	1	5/8" ID Needle Bearing	.75
MC 532	1	5/8" ID Shaft Seal	.50
MC 533	1	5/8" Snap Ring	.15
MC 534	2	10-24 x 1/2 BH Screws	.05
MC 535	1	10-32 x 1/4 BH Screw	.05
MC 536	1	10-32 x 1/4 SH Screw	.10
MC 537	1	3/8-24 x 1 HH Bolt	.10
MC 538	1	3/8 Lock Washer and Flat Washer	.03
MC 539	1	1/8 x 3/4 Tube	.20

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Exhibit 2a Go-Matic Parts List

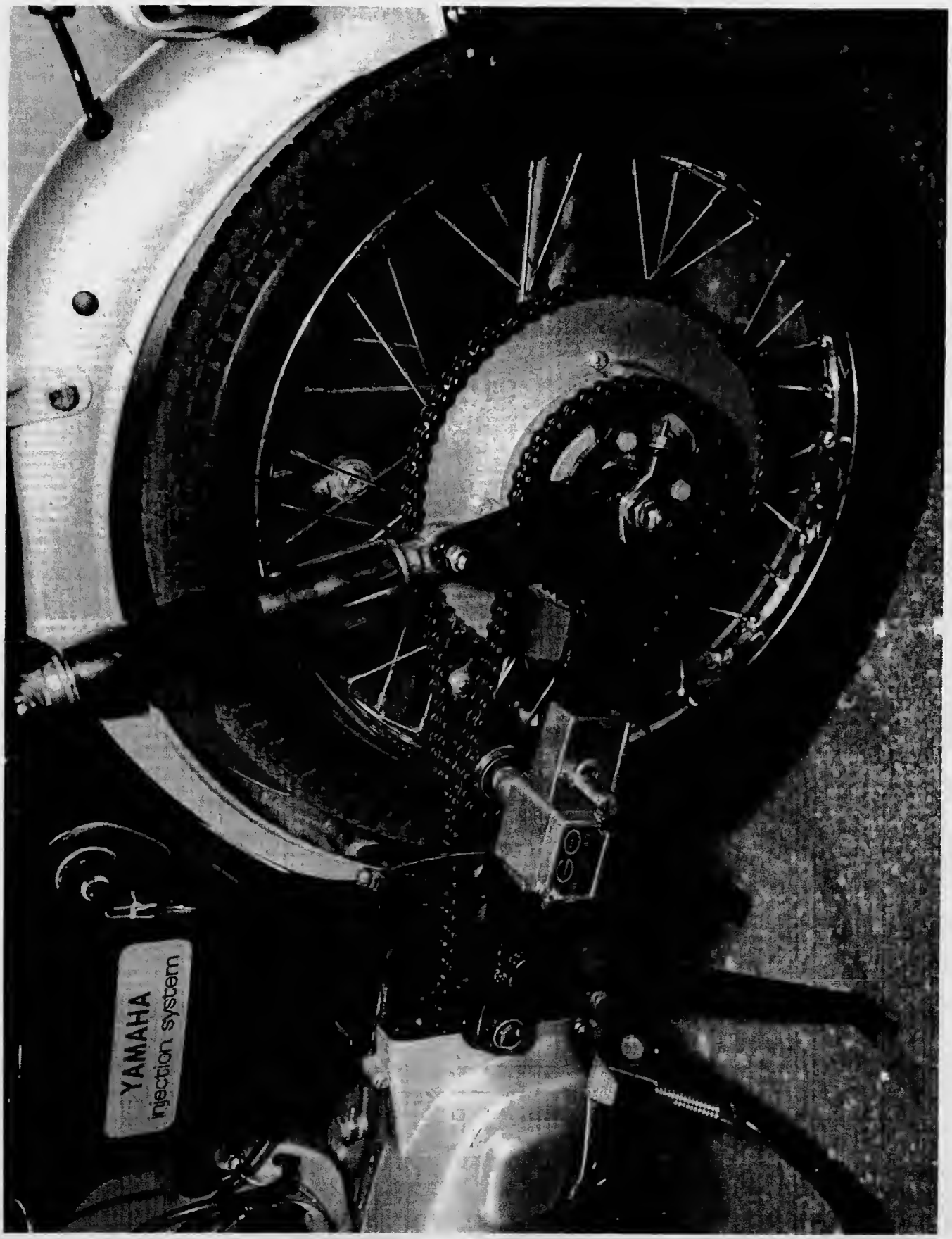


Exhibit 2b View of Go-Matic Installed on a Yamaha

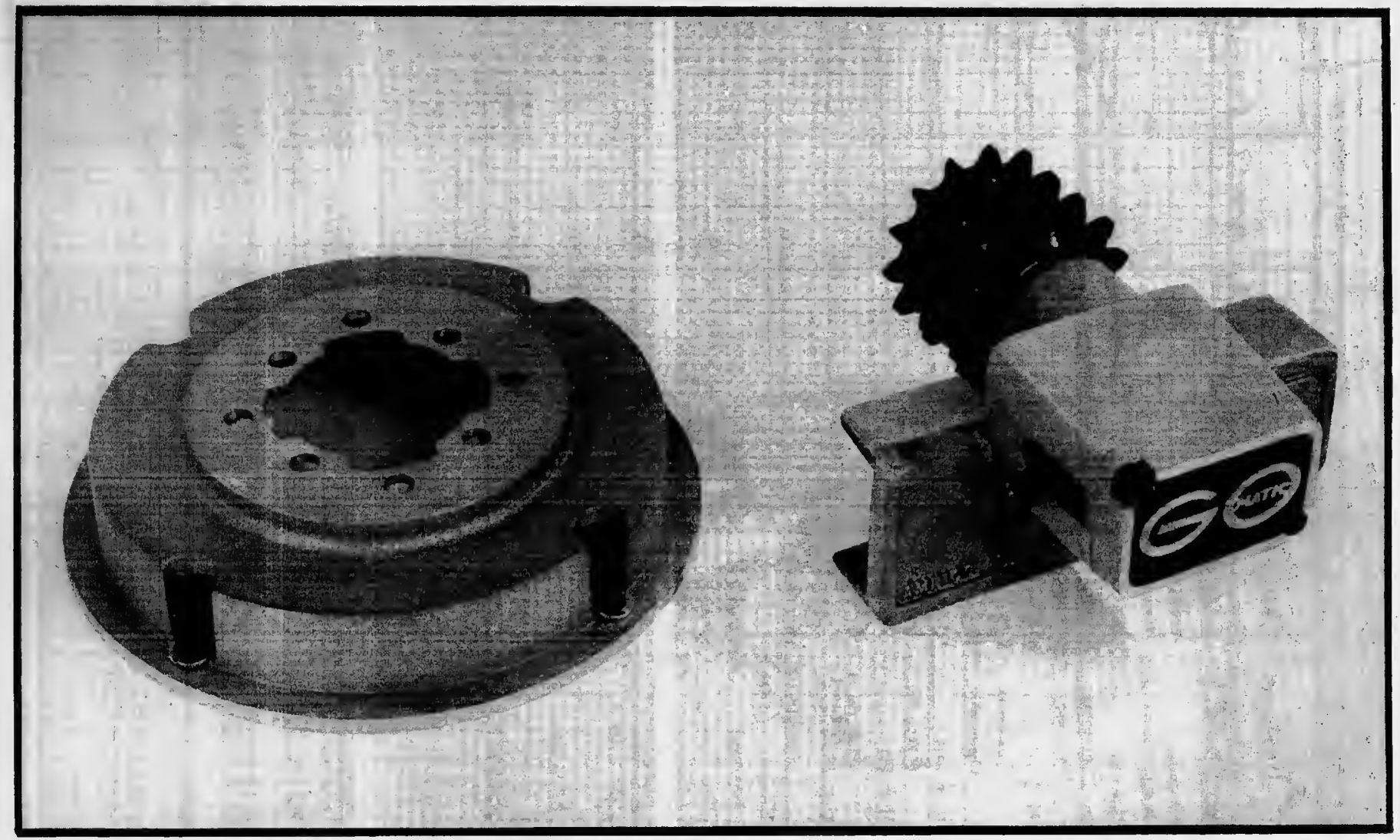


Exhibit 3 View of Prototype Go-Matic Gearbox and Hub

GO-MATIC SCHEDULING

INITIAL 1000 UNITS

DEALER DEMANDS AD MAILING CONTACTED — APPEARS

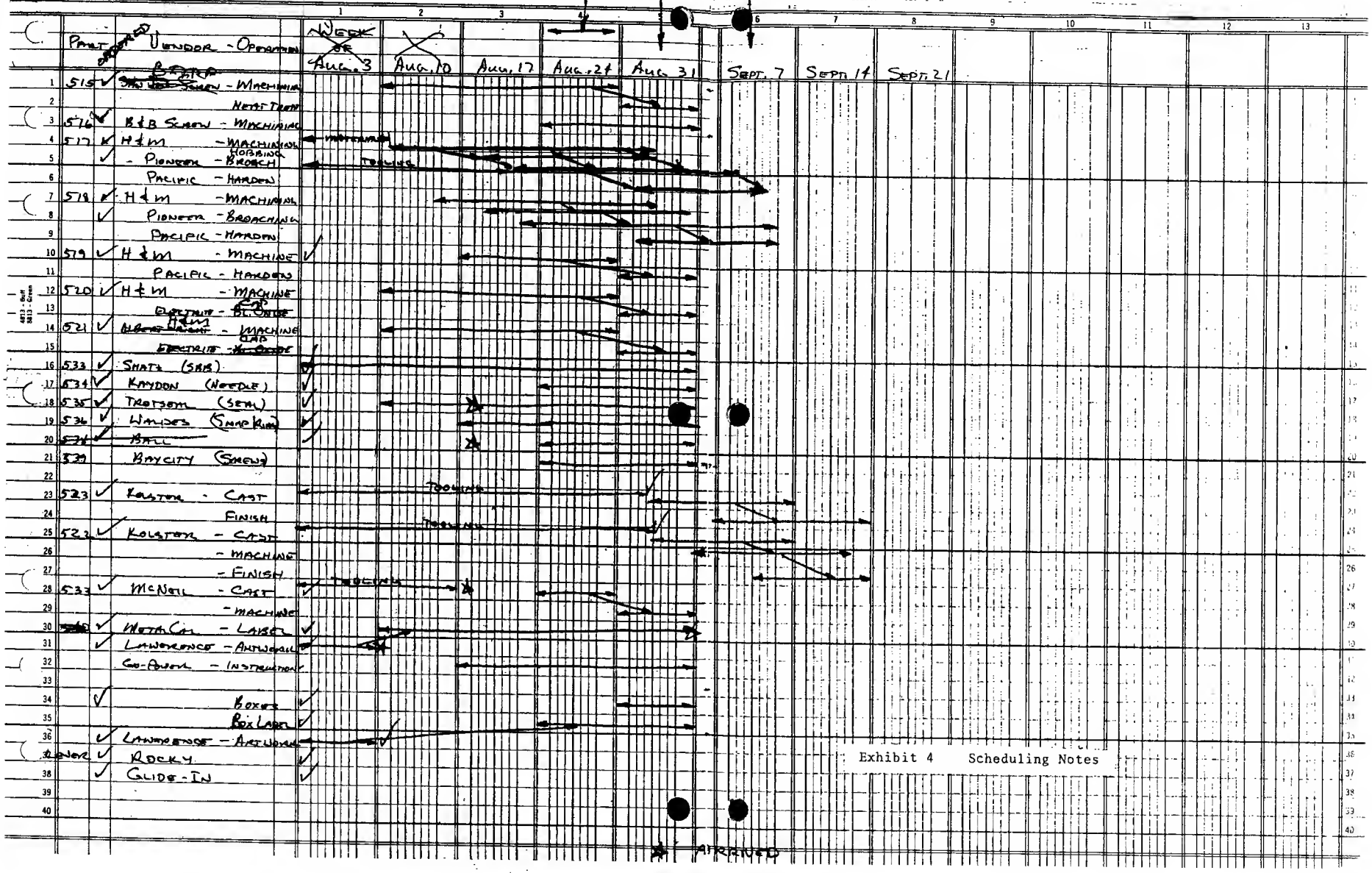


Exhibit 4 Scheduling Notes

W/o Box, Instructions, Royalty

ECL 113

Exhibit 5 Costing Notes

GoMatic Costing

Item	Part No.	(Includes Repairs) Present 500	Order 1000	Order 2000
Main Shaft	515	2.31	1.24	1.14
Actuator Shaft	516	.28	.14	.11
Driven Sprocket	517	1.48 x 2	1.48 x 2	1.33 x 2
Drive Sprocket	519	1.56	1.56	1.36
Driven Sprocket	513	1.67 x 2	1.48 x 2	1.33 x 2
Drive Sprocket	514	1.55	1.56	1.36
Drive Key	519	.58	.57	.38
Actuator Guide Shaft	520	.26	.26	.24
Actuator Lever	521	.27	.27	.25
Main Housing	522	}	}	}
Cap	523	.96	.96	.94
Filler Plug	524	}	}	}
Spring	525	.05	.05	.04
5/8 d Spacer	526	.02	.02	—
1 3/8 d Spacer	527	.02	.02	.02
Label	528	.07	.07	.07
Ball Bearing Inc	530	.55 x 3	.39 x 3	.36 x 3
Needle Bearing	531	.19	.19	.19
Seal	532	.15	.15	.13
Snap Rings	533	.06	.06	.06
Screw	534	.01	.01	.01
Screw	535, 536	.01	.01	.01
Bolt, Washers Grease Fitting	537	.03 / .07	.03 / .07	.03 / .07
Tube Grease	539	.02 .01	.02 .01	— .01
Handle		1.22	—	—
Cable		.60	—	—

GO-MATIC KITS

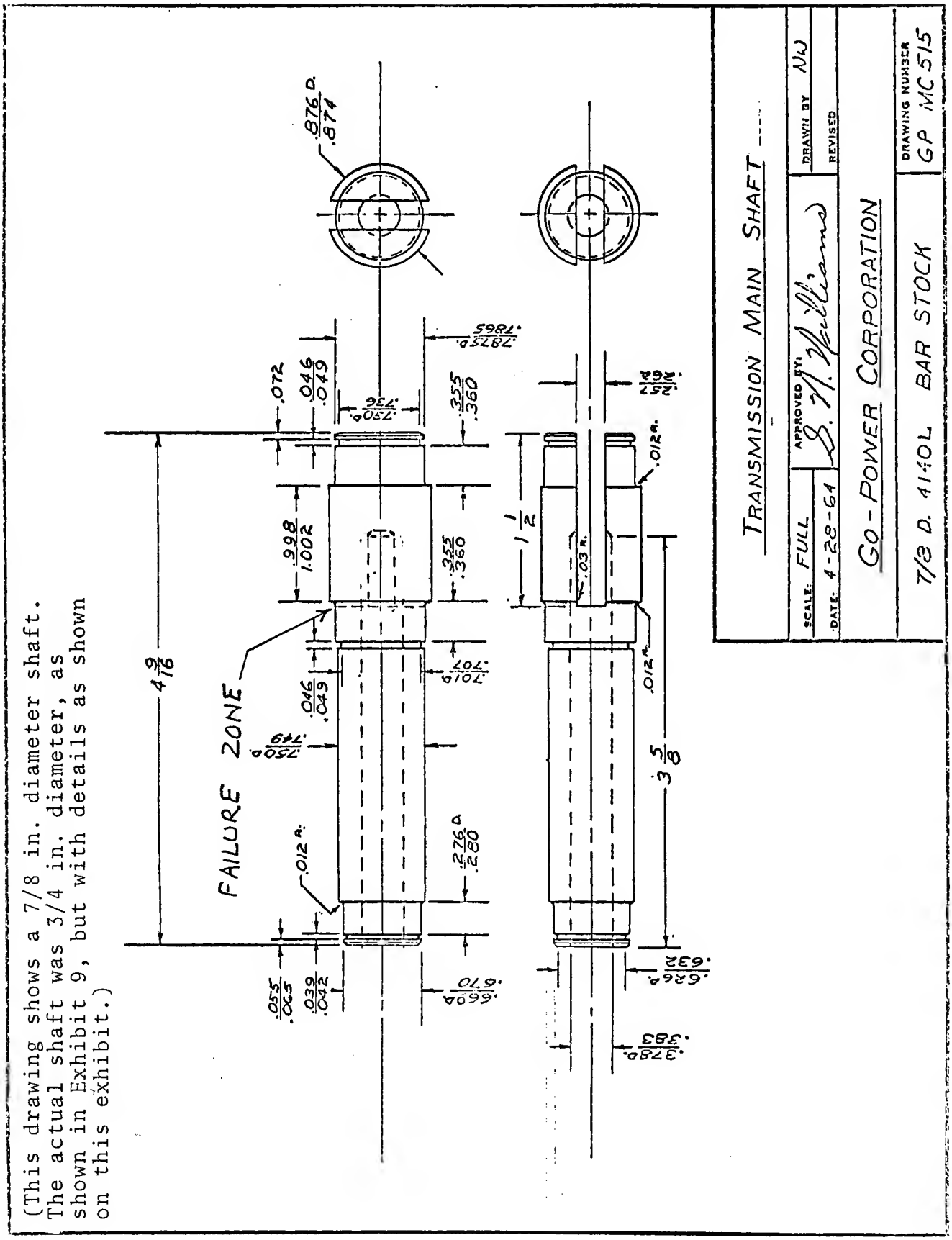
	List Price	Dealer Disc.	Cost First 1000	Gross Margin	Cost 2000 Quantity	Gross Margin	Cost 2000 P.W.	Gross Margin
5% Honda CT 200	$42.95	33⅓%	$18.45	36%	$15.04	47%	$11.93	58%
		40%	18.45	28%	15.04	(41%)	11.93	54%
5% Honda CA 200	57.95	33⅓%	22.83	41%	18.51	52%	15.40	60%
		40%	22.83	35%	18.51	(47%)	15.40	56%
~~5% Honda 90's~~	~~60.95~~	~~33⅓%~~	~~23.33~~	~~43%~~	~~19.01~~	~~53%~~	~~15.90~~	~~61%~~
		~~40%~~	~~23.33~~	~~36%~~	~~19.01~~	~~48%~~	~~15.90~~	~~56%~~
5% Honda 50's	57.95	33⅓%	21.84	43%	18.38	52%	15.27	60%
		40%	21.84	37%	18.38	(47%)	15.27	56%
15% Yamaha 50,80	$55.95	33⅓%	$20.70	43%	$17.41	55%	$14.30	63%
		40%	20.70	41%	17.41	(50%)	14.30	59%
15% Yamaha 80 Trail	63.95	33⅓%	22.05	48%	17.76	58%	15.75	63%
		40%	22.05	46%	17.76	(54%)	15.75	59%
10% Suzuki 50,80	55.95	33⅓%	20.18	46%	16.91	54%	13.90	63%
		40%	20.18	40%	16.91	(50%)	13.90	59%

	Dealer Disc.	First 1000	Second 2000	2000 Qty P.W.'s
Wt. Avg. Margin	33⅓%	~~47%~~ 41%	51%	60%
	[40%]	~~34%~~ 34%	[~~46%~~ ~~60%~~ 65%]	[56%]
	0%	~~52%~~ ~~64%~~ 60%	~~32%~~	74%

Avg. List Price $51.30

Avg. Dealer Price (40%) 30.80

Avg. Margin $10.50 $14.15 $17.20



(This drawing shows a 7/8 in. diameter shaft. The actual shaft was 3/4 in. diameter, as shown in Exhibit 9, but with details as shown on this exhibit.)

Exhibit 7 Drawing, Transmission Mainshaft

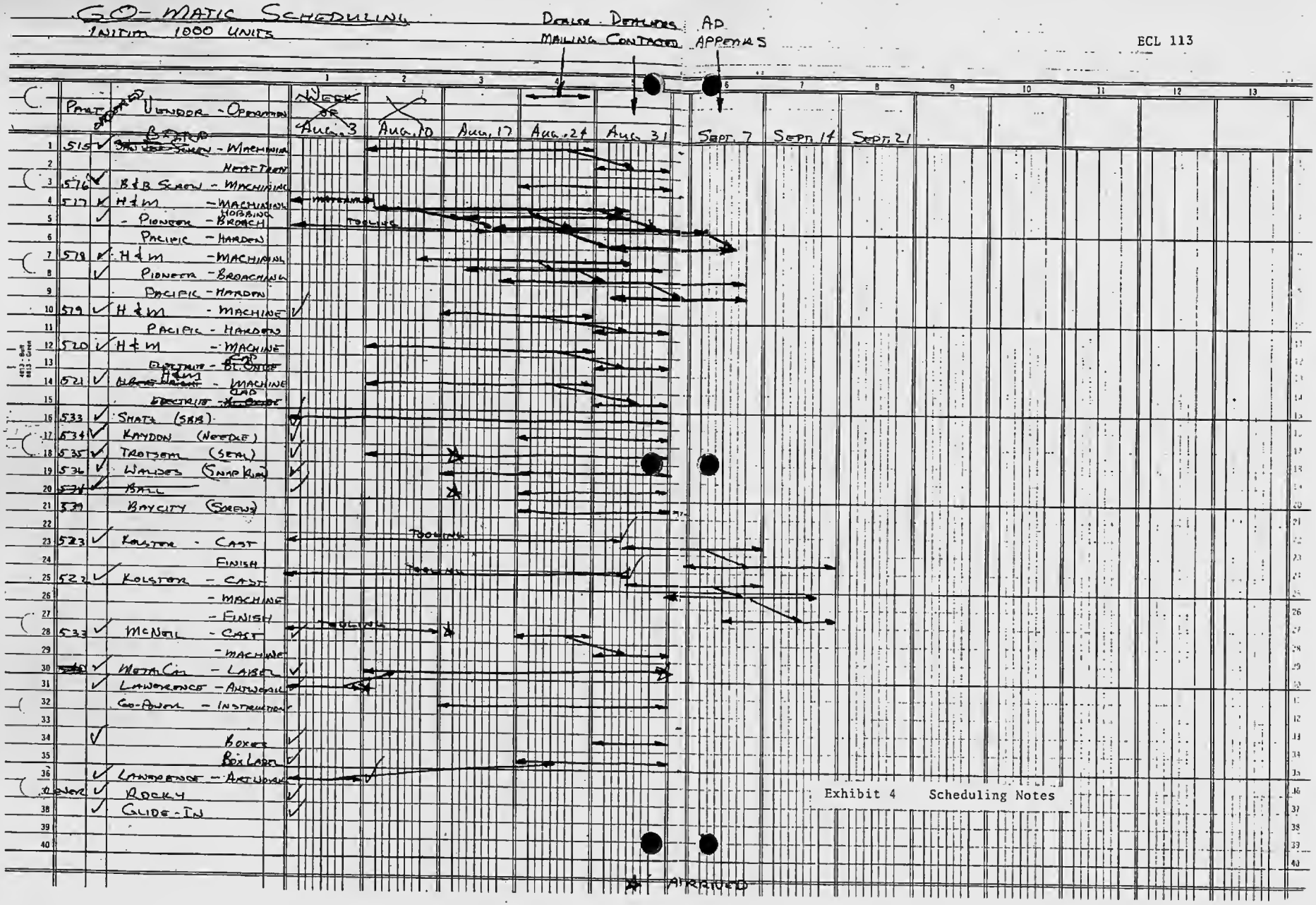
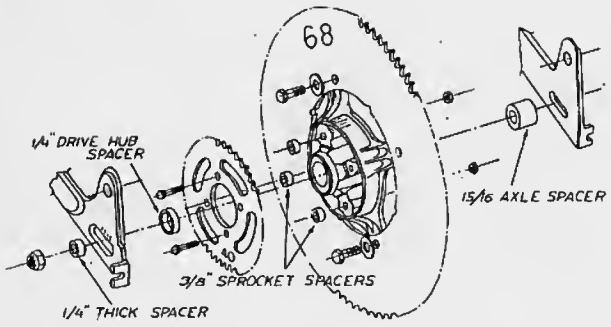
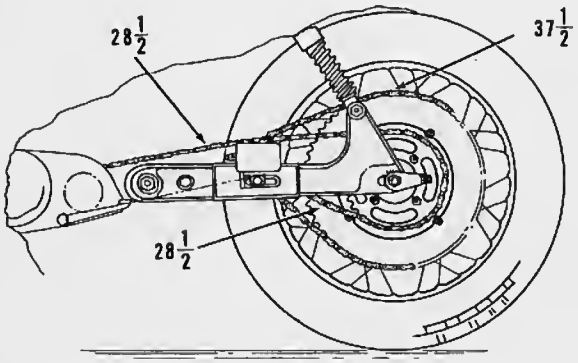
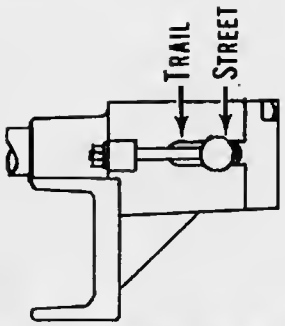
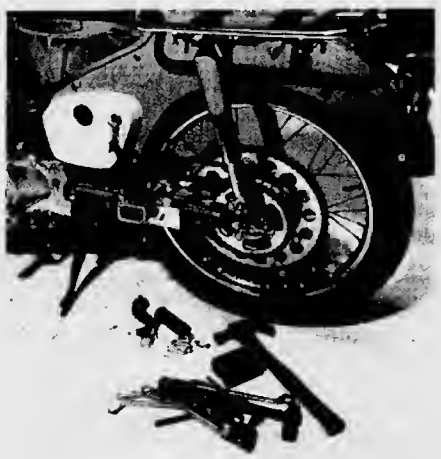


Exhibit 4 Scheduling Notes









7. Unbolt the 40T Honda sprocket from the drive hub and put the four 3/8 thick aluminum spacers between the 40T sprocket and the hub. Then bolt the sprocket to the drive hub with the four 5/16-18 x 1-3/4 long bolts from the Go-Matic kit. Use the standard Honda nuts and bolt tab locks. (These have a slightly different thread which give the nut and bolt a desirable locking action). Tighten the bolts snug but not tight and do not bend over the locking tabs yet.
8. Reinstall the swing arm, swing arm bolt, and rear spring bolts. Leave the nut off of the lower left spring bolt for sprocket bolt clearance. Then slip the Go-Matic onto the swing arm and install the front chain and connecting link with the keeper on the wheel side of the chain. Use the 3/8-24 x 1" bolt, lock washer, and flat washer to bolt the Go-Matic to the swing arm with the front chain medium tight. Never exceed 10 ft. lbs. of torque.
9. Reinstall the rear wheel and sprockets, using the 15/16" long Go-Matic spacer to replace the standard steel spacer on the right side of the wheel. Also use the 1/4" thick Go-Matic spacer between the hub and the swing arm on the left side of the 1/4" thick steel spacer underneath the axle nut.
10. Install the 28-1/2" long chain on the 40T sprocket and Go-Matic sprocket and the 37-1/2" long chain on the 68T sprocket. Put the connecting link keepers on the wheel side of both chains for clearance. Reinstall the brake rod, brake torque arm, and adjust rear chains temporarily to medium tightness. (note: worn or stretched chains may not give proper chain tension. If the chain is too loose, use a piece of new chain.)
11. If the sprocket bolts hit the lower rear chain guard mount, bend it out slightly for clearance. With Go-Matic in neutral (middle) position, spin rear wheel to see if rear sprockets are centered. If they are not, the chains will tighten and loosen with each revolution. With the chain in its tightest position, tap the sprocket slightly toward the Go-Matic. Repeat this till the sprocket seems centered and then tighten. Tighten the hub bolts and bend over the locking tabs. Readjust the rear chain tension and tighten both axle nuts. Caution: Be sure to pay special attention to this sprocket centering operation. Eccentric sprockets is the greatest cause of erratic Go-Matic performance.
12. To shift sprocket from street to trail, stop the bike in neutral and loosen the knurled Go-Matic thumb screw 1/4 turn. Push the Go-Matic lever toward the desired position and move the bike slightly forward (or spin rear wheel) to synchronize the shifting mechanizm. When it is lined up, it will shift easily. Then re-tighten the screw. Never force the lever by hammering. If it won't shift when lined up, the Go-Matic is probably worn or clogged with dirt. Dissassemble and clean it or return it to the factory for service.
13. Maintenance: The Go-Matic is lubricated when it comes from the factory. Every 1,000 to 2,000 miles of use, it should be greased. If the shaft seal is pushed out by the grease gun, clean the grease from behind it and tap the seal back into place after greasing. If it is then hard to shift, grease has probably been forced in behind the plunger. Remove the 5/8" diameter plunger, clean out the grease, and reinstall it. After the first hour of running with new chains, it will be necessary to readjust the chain tension to compensate for chain stretching.

Spare parts can be obtained by writing to:

GO POWER CORPORATION 155 Montgomery Street • San Francisco, California

Exhibit 8 Instruction Sheet for Go-Matic Installation (sheet 2 of 2)

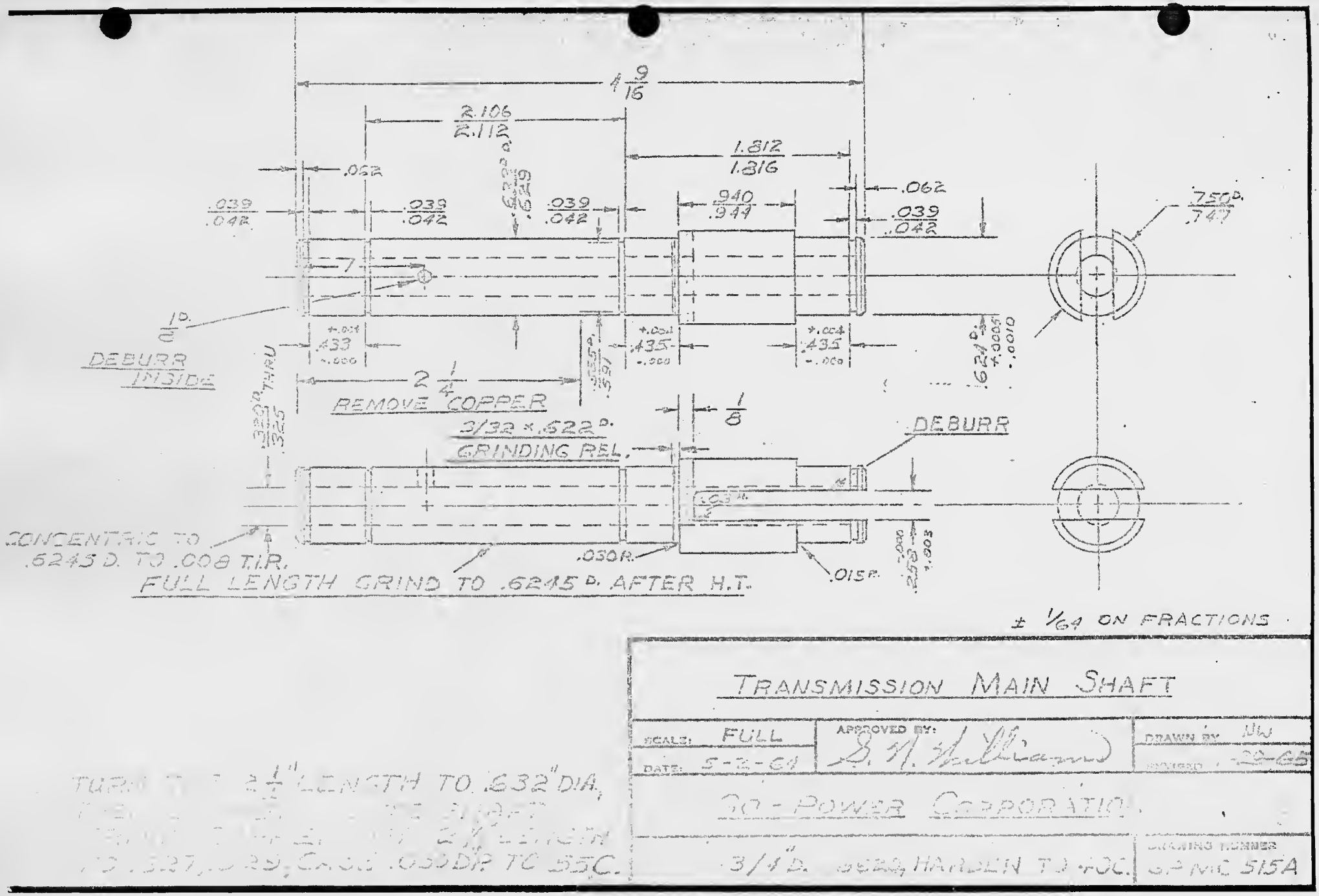


Exhibit 9 Revised Drawing, Transmission Mainshaft

ECL 11: